

Aerosol Optical Properties in Mexico City 2003 and 2006

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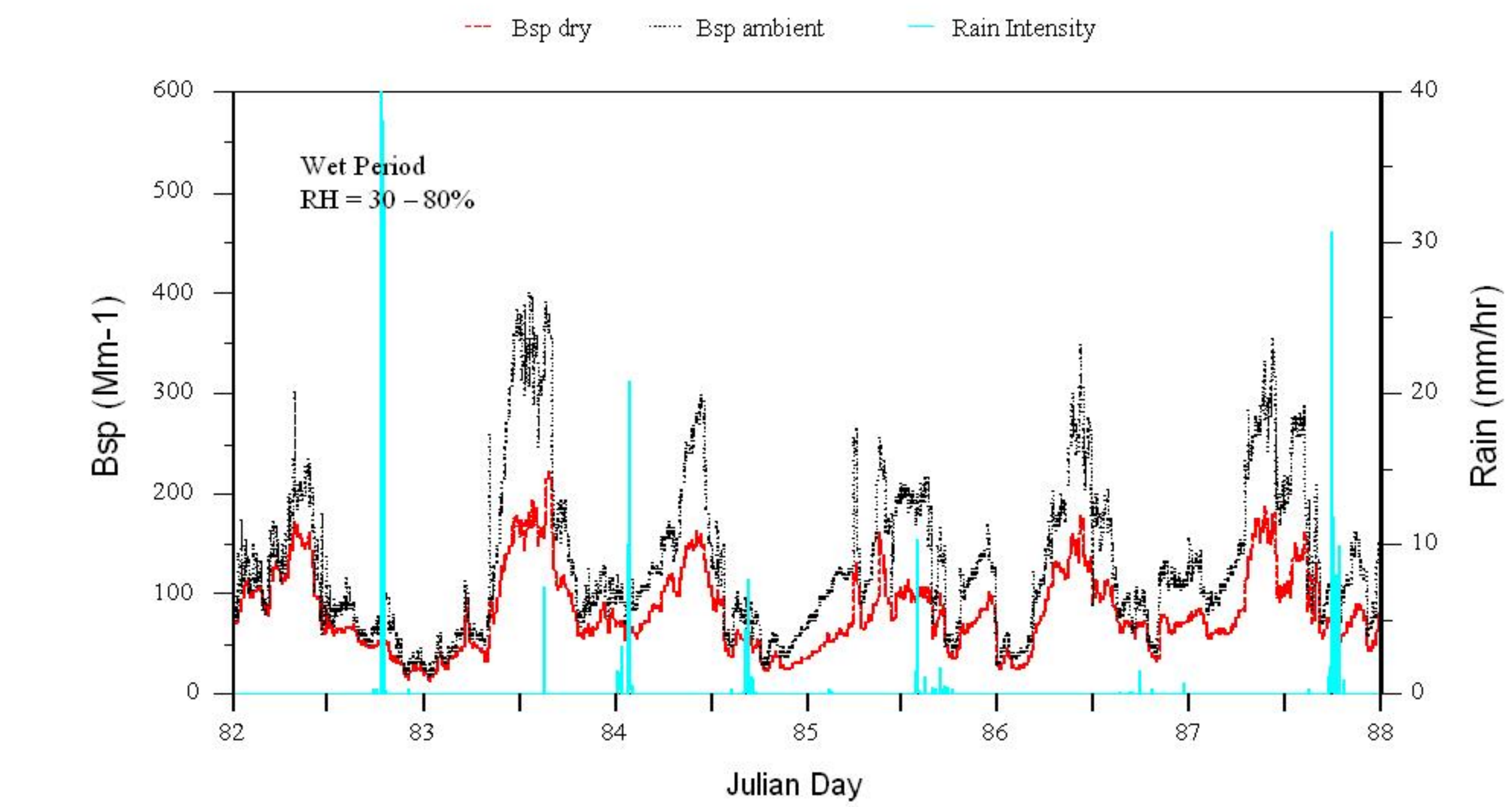
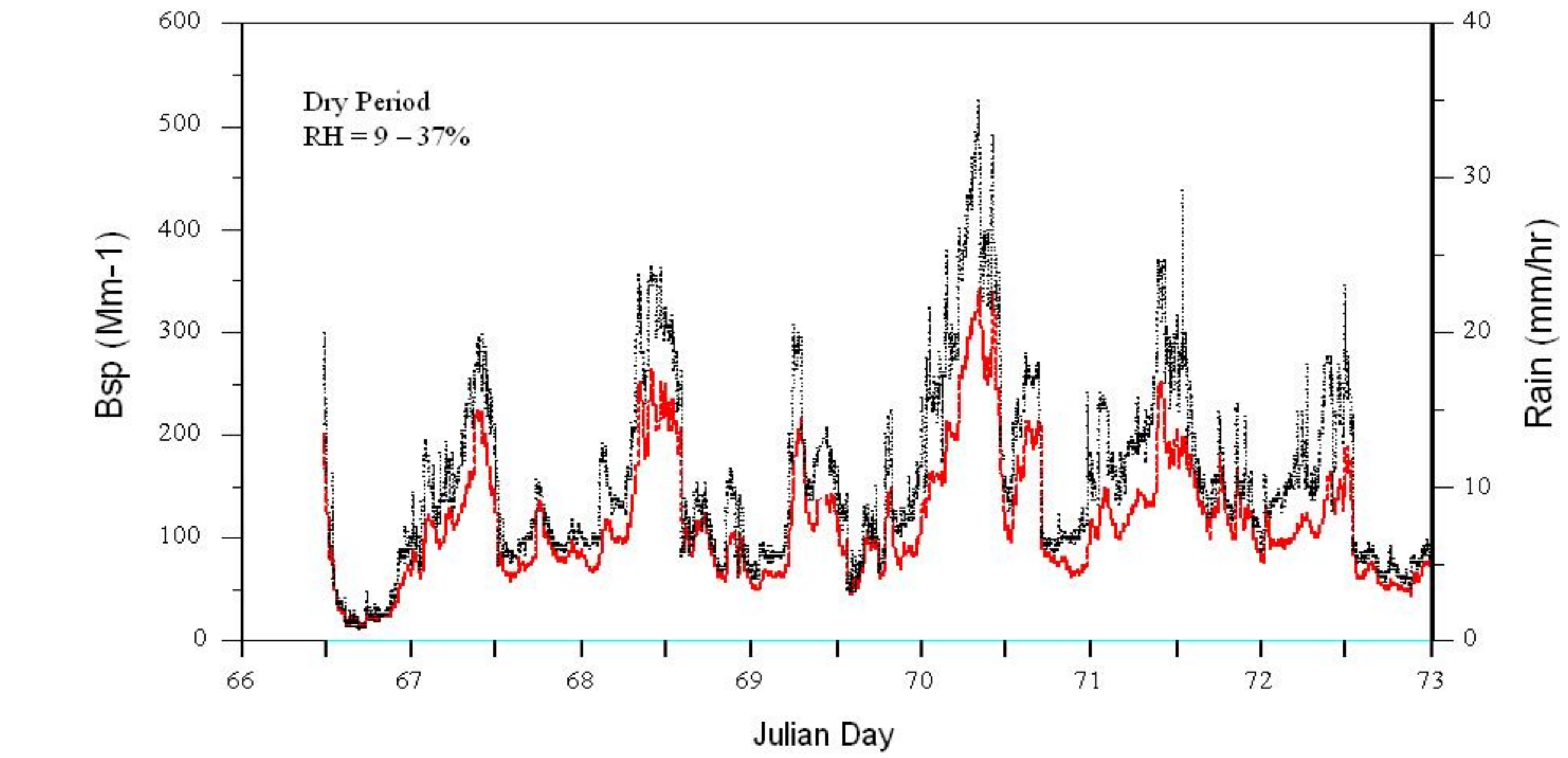
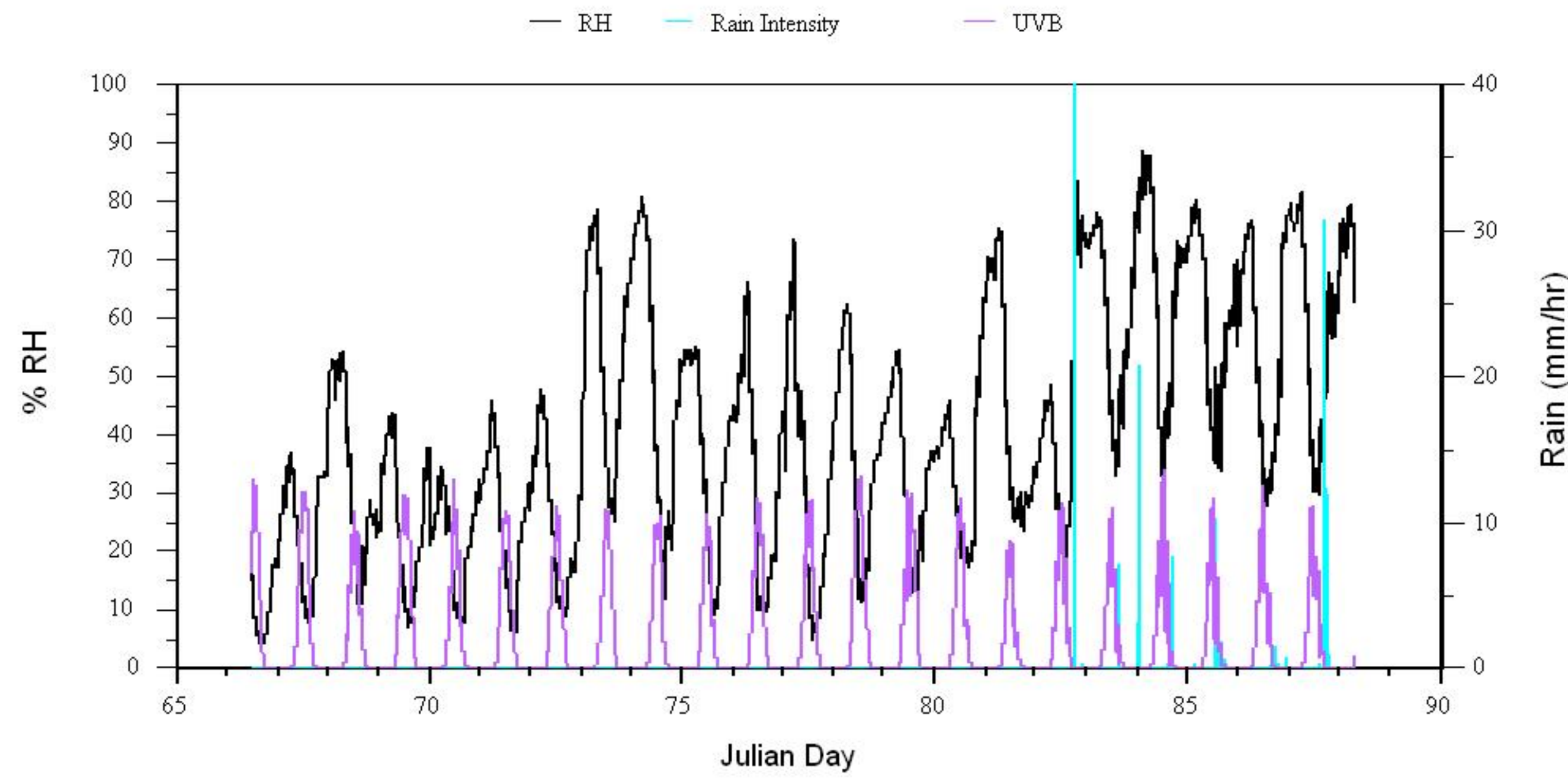
ABSTRACT

Measurements of aerosol absorption were obtained at site T0 at 7 wavelengths (370, 470, 520, 590, 660, 880, and 950 nm) and measurements of aerosol scattering were obtained at 3 wavelengths (450, 550, and 700 nm) at 5-minute and 1-minute time resolutions, respectively. Aerosol scattering measurements were also obtained under wet (99% RH) and dry (20% RH) conditions at 550 nm. The first 7 days of the study period were dry with an average RH of 28.7%, the last 7 days of the study period was relatively wet with an average RH of 56.5% and 6 rain events. Particle scattering was slightly higher during the dry period with an average daily maximum of 350 Mm⁻¹ compared with an average daily maximum of 300 during the wet period. The difference between ambient and dry particle scattering was higher during the wet period with a maximum difference of 350 Mm⁻¹ compared to that of 250 Mm⁻¹ during the earlier dry period.

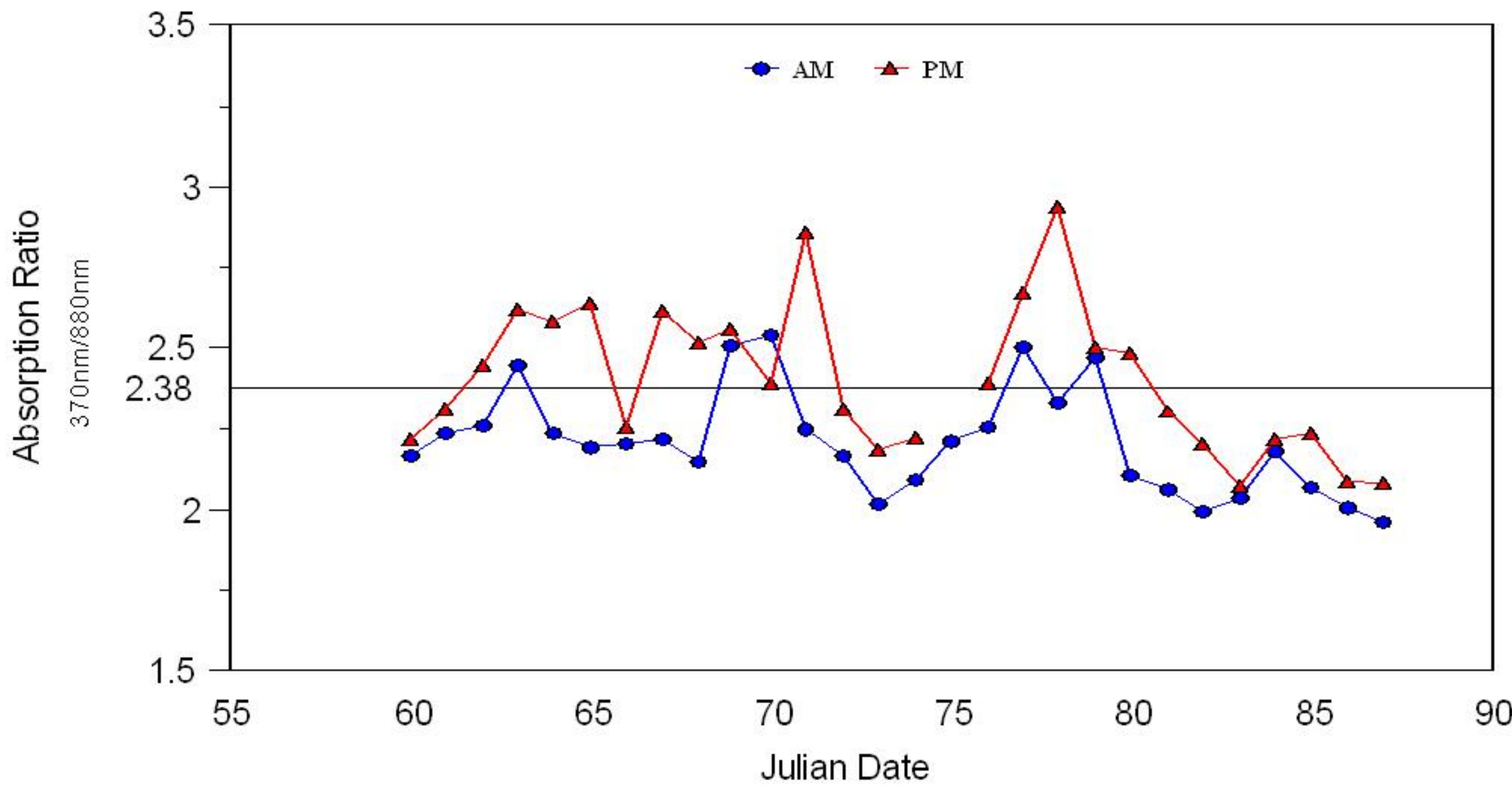
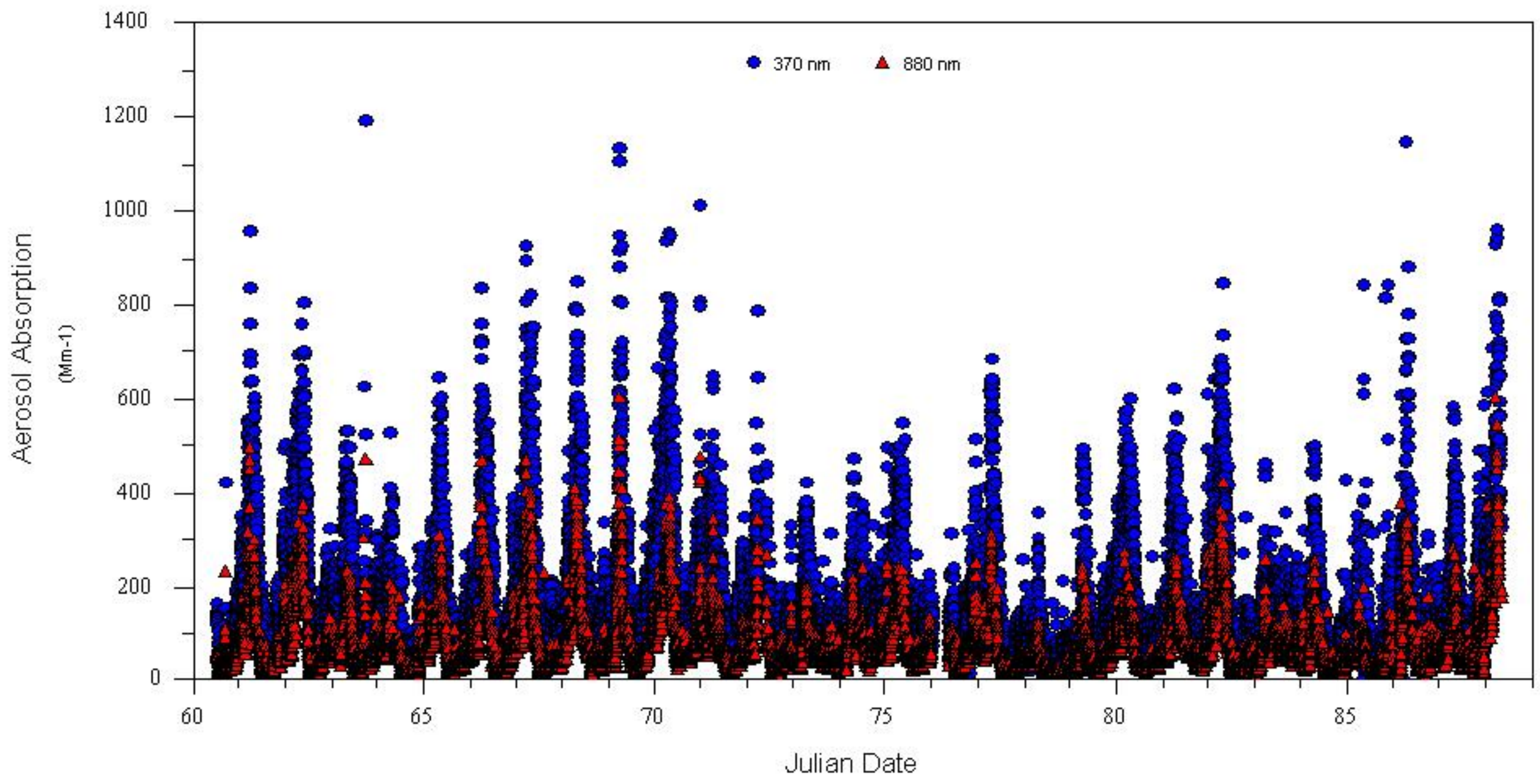
Aerosol absorption at 880 nm was very similar to that measured in 2003, with an average of 70 Mm⁻¹ and a maximum of 600 Mm⁻¹. The ratio of aerosol absorption at 370 nm to that at 880 nm was generally higher in the afternoon than the morning hours, indicating an increase in secondary aerosol formation and photochemically generated UV absorbing species in the afternoon. For particles with a purely $1/\lambda$ absorption dependence, typical of carbon soot, this ratio would be expected to be 2.38. Some absorbance ratios fell below this value. This is possibly due to the presence of biogenic aerosols that absorb more strongly in the visible and near IR.

Aerosol absorption ratios obtained in 2003 gave similar patterns during the beginning of the study period. However, the ratios were much higher during the last week of the study for both morning and evening hours. This was shown to be due to long-range transport from a biomass burning event which directly impacted Mexico City during the later part of the month. Carbonaceous aerosols generated from biomass burning have been shown to have a stronger wavelength dependence than that expected from BC alone (1). The most abundant organic compounds detected in fine particulate matter from biomass burning events have been identified as the sugar anhydrides, galactosan and mannosan and levoglucosan, as well as polycarboxylic acids (HULIS) which are well known UV absorbers (2).

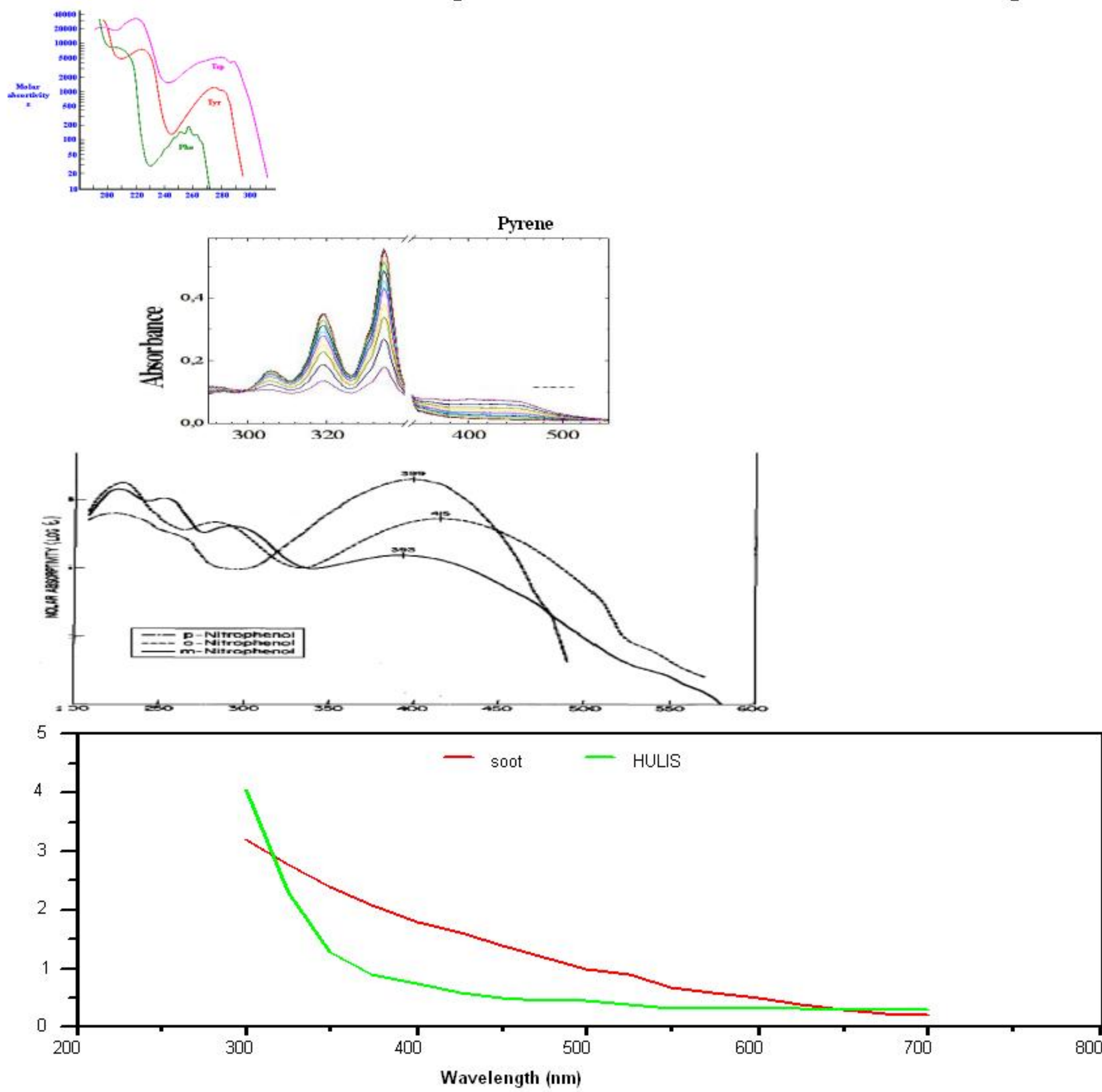
1. T.W. Kirchstetter and T. Novakov, 2004. "Evidence that the spectral dependence of light absorption by aerosols is affected by organic carbon." *J. Geophys. Res.* **109**, D21205.
2. O.L. Mayol-Bracero, P. Oyoun, B. Graham, M.O. Andrea, S. Decesari, M.C. Facchini, S. Fuzzi, and P. Arzoo, 2002. "Water-soluble organic compounds in biomass burning aerosols over Amazonia. 2. Apportionment of the chemical composition and importance of the polycyclic fraction." *J. Geophys. Res.* **107**, D20,809.



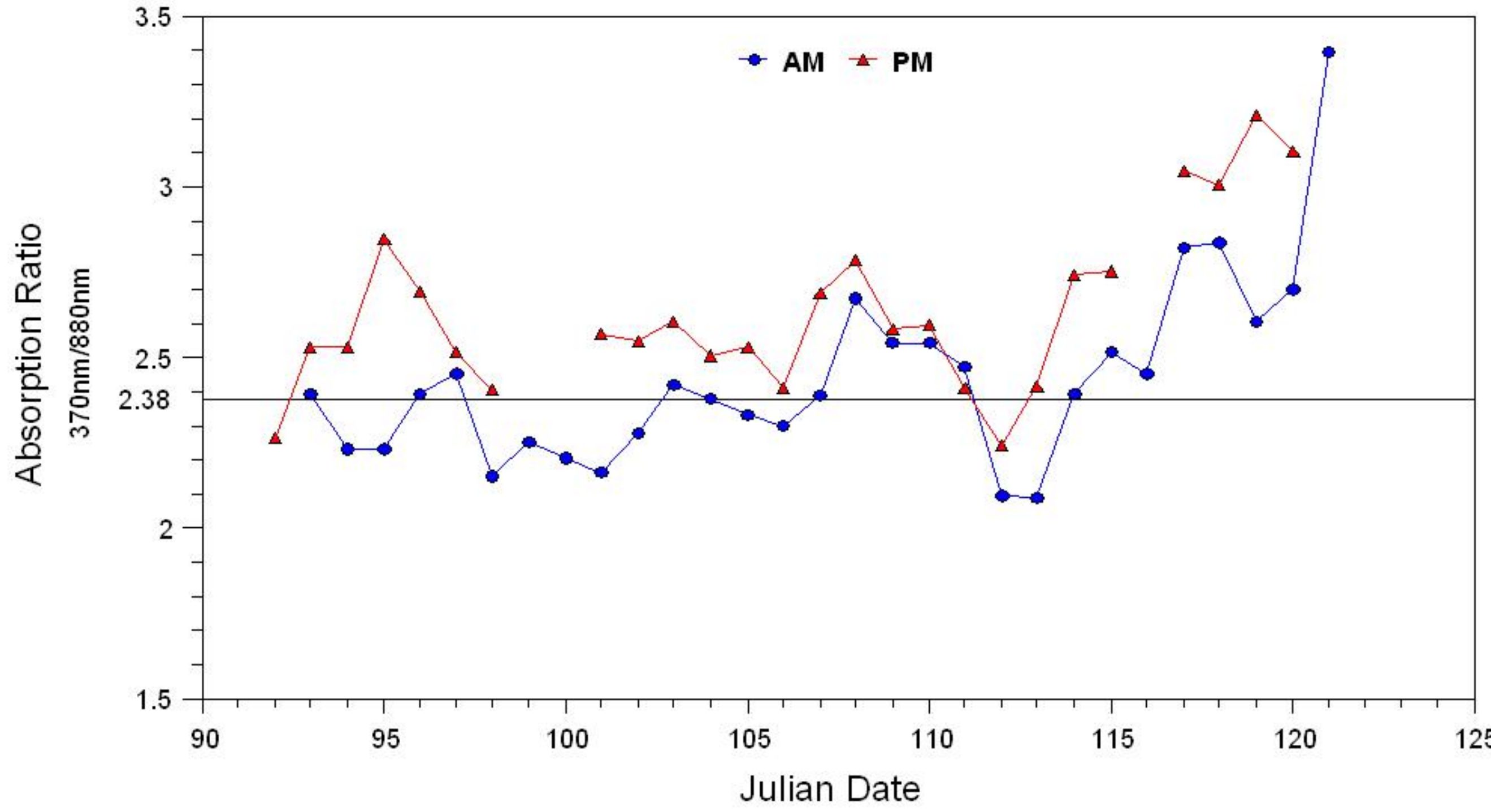
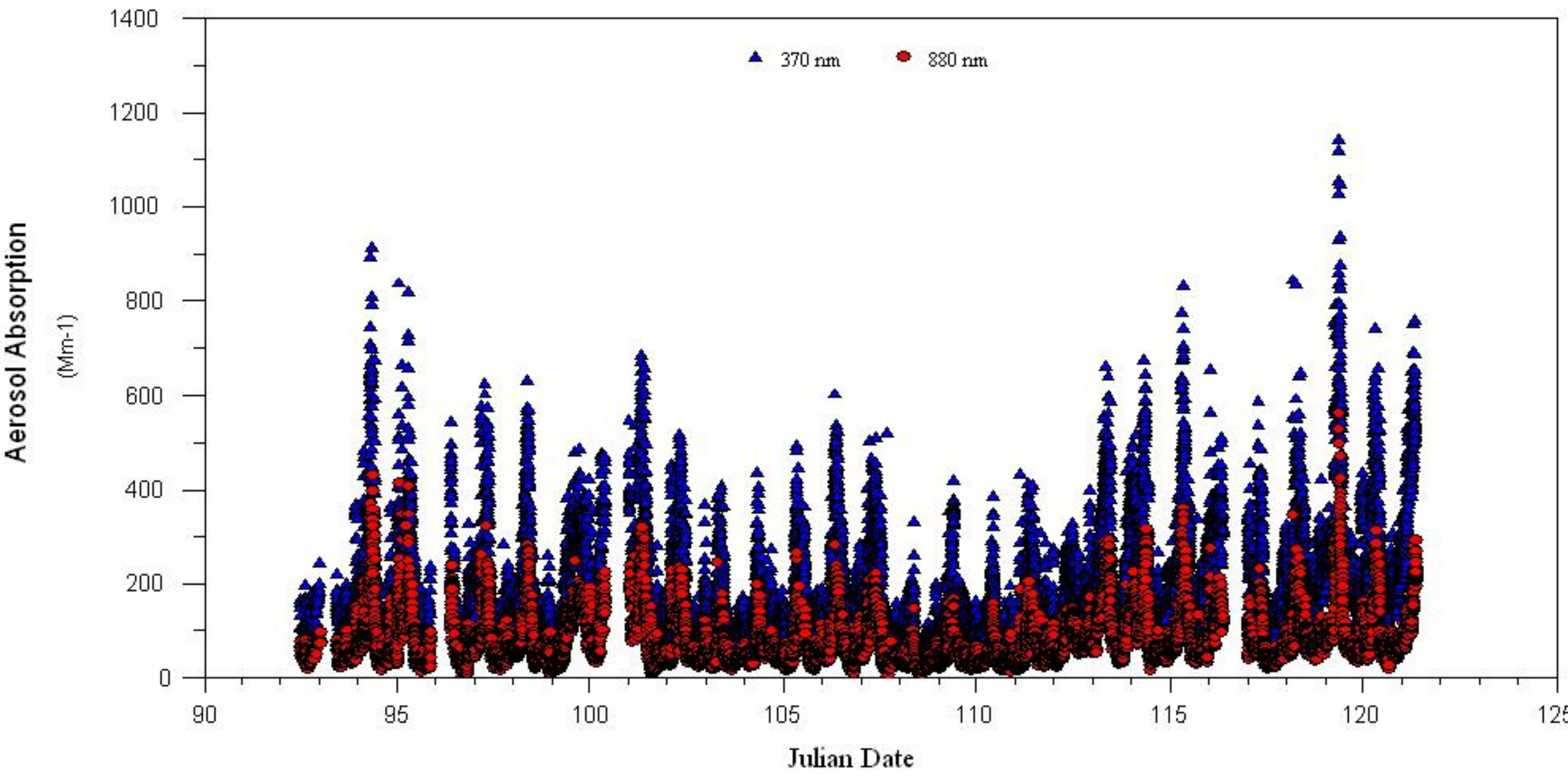
Mexico City – March 1 – 29, 2006



Absorption Profiles of Some Aerosol Components

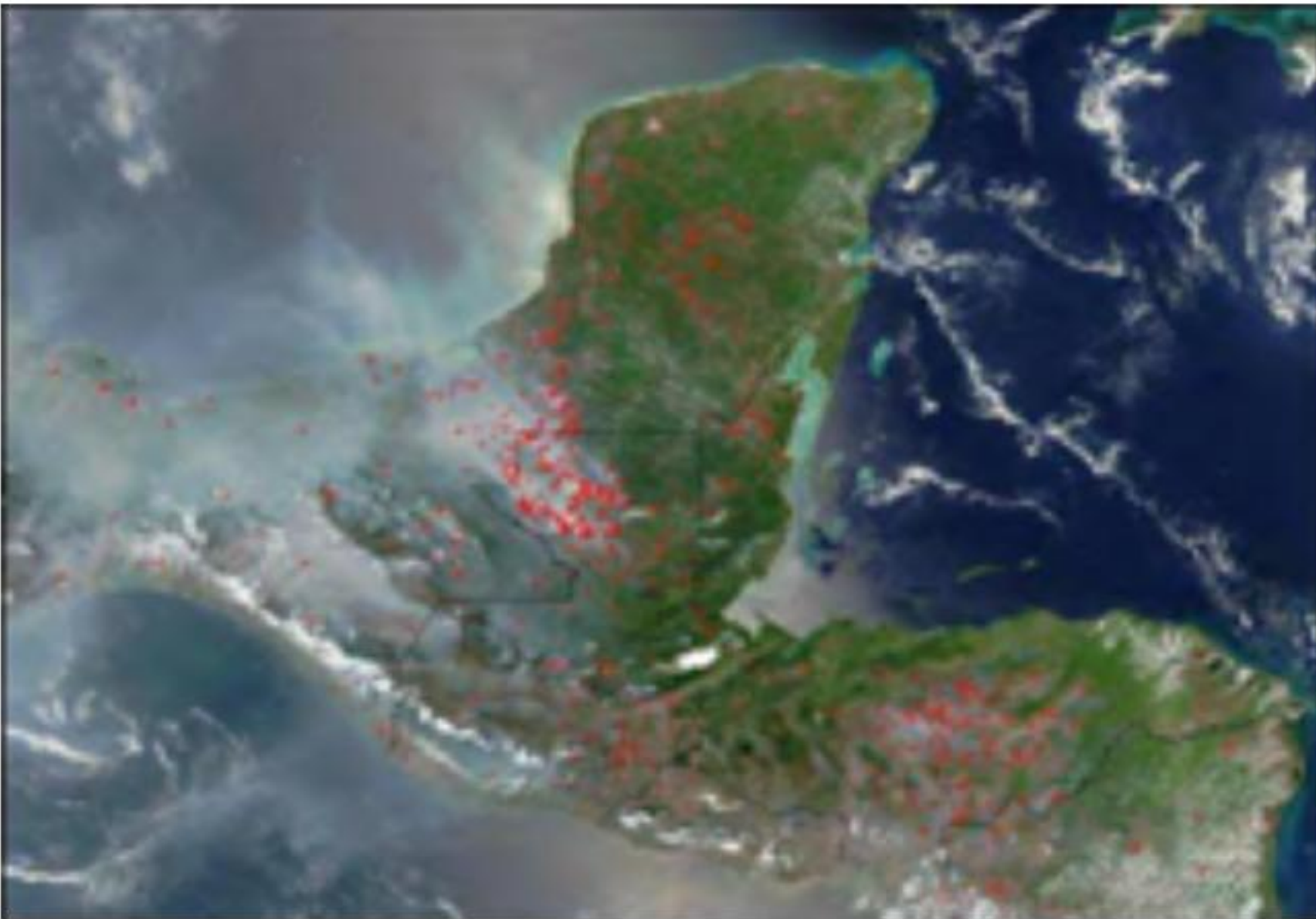


Mexico City – April 2 – May 1, 2003



Since the absorbance of fine particulates with a broadband absorption profile, such as black carbon aerosols, will exhibit an inverse wavelength dependence ($1/\lambda$), the UV absorption is expected to be greater than that in the near infrared. The variation of the ratio of absorption at 370nm to that at 880 nm gives an indication of aerosol components with enhanced UV absorption over that expected from BC content alone. For particles with a purely $1/\lambda$ absorption dependence, this ratio would be expected to be 2.38.

The aerosol absorption observed in Mexico City during April 2003 gave ratios from 2.03 to 3.21 with the largest values occurring later in the study period. The aerosol absorption during March 2006 gave ratios from 1.96 to 2.94. In general, the 370nm/880nm absorption ratio was higher in the afternoon than the morning hours, indicating an increase in secondary aerosol formation and photochemically generated UV absorbing species in the afternoon. The 370nm/880nm ratios were much higher during the last week of the study in 2003 for both morning and evening hours. Aerosol samples collected by high volume impactors during this later period were analyzed for ¹⁴C using accelerator mass spectrometry (12). Results of the biogenic to fossil carbon ratios in these aerosol samples were found to be 70% biogenic. In addition, analysis of satellite data indicated that the plumes from the biomass fires in the Yucatan impacted the Valley of Mexico during the entire month of April 2003 with the highest impacts on Mexico City during the last week of April.



ACKNOWLEDGEMENT

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